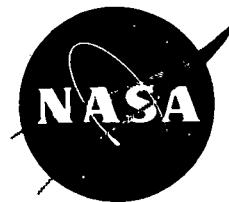


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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

TELS. WO 2-4155  
WO 3-6925

**FOR RELEASE: IMMEDIATE**  
July 9, 1965

RELEASE NO: 65-227

## **PROJECT: MARINER MARS ENCOUNTER**



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(NASA-News-Release-65-227) MARINER TO  
CLIMAX UNPRECEDENTED MARS MISSION 14 JULY  
(NASA) 56 p

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NEWS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

TELS. WO 2-4155  
WO 3-6925

**FOR RELEASE:**

IMMEDIATE  
July 9, 1965

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MARINER TO CLIMAX

UNPRECEDENTED MARS

MISSION JULY 14

Close inspection of the planet Mars by the United States Mariner IV spacecraft July 14 will bring to a climax an exploratory mission of unprecedented distance and complexity.

Delicate, but rugged, instruments which will have endured 228 days in space will act as the eyes of mankind. They will observe and measure interesting aspects of the red planet from a distance of within 5700 miles.

The closest that Mars and Earth ever come in their separate orbits around the Sun and the narrowest distance possible, once every 15 years, for ground-based telescopic observations is 35 million miles.

By the time of encounter, the National Aeronautics and Space Administration's spacecraft will have traveled 325 million miles along a wide-swinging path designed to intersect the orbit of Mars.

-more-

7/8/65

CONTINUOUS REPORTS

Mile-by-mile along that 325-million-mile stretch, Mariner IV has reported back to Earth how it was functioning and what it was encountering in space. Since its launch from Cape Kennedy, Fla., Nov. 28, 1964 Mariner IV has supplied scientists with millions of bits of information on such interplanetary phenomena as solar wind, cosmic dust, magnetic fields and radiation.

The straight-line distance of Mariner from Earth will be 134 million miles when the spacecraft passes near Mars.

Useful information from the historic mission was quick in coming. On the first day of flight, Mariner IV detected the shock wave produced by the solar wind on the Earth's magnetic field at a greater altitude than this phenomena had ever been observed before.

Soon afterward the trapped radiation detector on this spacecraft recorded the best measurement yet made on the outer regions of the Van Allen radiation belts.

The Mariner IV mission was undertaken because of the great physical and geological interest in Mars because it offers what is believed to be the best opportunity within our solar system of shedding light on the possibility of life in some form, plant or animal, existing beyond the Earth. The search for extraterrestrial life will be conducted in future NASA missions to Mars.

The Mariner IV mission also serves to spotlight United States' commitment to expand human knowledge of space. The National Space Act of 1958 created NASA and called on the civilian agency to plan and conduct those activities in space "devoted to peaceful purposes for the benefit of all mankind."

#### MANDATE FOR EXPLORATION

The lunar and planetary exploration program was one of the first programs to be started by NASA. Selected as the most reasonable goals for initial exploration were the Moon and Venus and Mars, the closest planets to Earth.

Design of the Mariner series of spacecraft began in 1961. Mariner II completed the world's first successful

trip to the vicinity of Venus Dec. 14, 1962. Its data determined the planet's surface temperature to be about 800 degrees Fahrenheit with a temperature range of minus 30 to 70 degrees at the tops of the clouds that surround and shroud the planet. It also gathered much significant information on interplanetary space.

Mariner IV weighs 575 pounds, about 125 more than Mariner II and has some 138,000 individual parts. It has a design lifetime of 6,500 hours compared with Mariner II's 54,000 parts and 2,600-hour design lifetime. Mariner IV exceeded 5,000 hours in space June 24.

#### PRECEDENTS, RECORDS SET

Since April 29, Mariner IV has set new communications distance records every day. By the time it has finished transmitting all desired data the communications distance will be about 150 million miles.

This initial attempt of the United States to explore Mars with an unmanned spacecraft also is the first flight outside of the Earth's orbit away from the Sun. Another first is the use of the star Canopus for a spacecraft attitude reference.

Attesting to the accuracy and reliability of many vital components, such as the Atlas-Agena launch vehicle, the midcourse motor, attitude controls and the like, is the fact that with a flight path of about 325 million miles the miss from the aiming point will be only about 1,000 miles.

- more -

#### WHAT'S HAPPENED SO FAR

At 9:22 a.m. EST, Nov. 28, 1964, Mariner IV lifted from the pad at Cape Kennedy and began its 228-day flight to the planet Mars.

The launch vehicle was an Atlas-Agena. Earth and the spacecraft at the time of launch were than 129 million miles from Mars.

The Earth was travelling about 66,000 miles per hour in a near-circular solar orbit averaging about 93 million miles out from the Sun. Mars was moving about 54,000 miles per hour in an orbit averaging 140 million miles from the Sun.

#### OBJECTIVES OF MISSION

Objective of Mariner IV was to perform scientific measurements in interplanetary space between the orbits of Earth and Mars and in the vicinity of Mars and to gain engineering experience in operating spacecraft during long-duration missions aimed away from the Sun.

Six of the eight Mariner IV scientific investigations (experiments) were designed to measure radiation, magnetic fields, and meteoroids in interplanetary space and near Mars. The other two depended on everything going well right up to the closest approach to Mars. One was a single television camera to take about 21 pictures of the planet and the other was an occultation experiment designed to shed light on the Martian atmosphere.

The Mariner trajectory was carefully planned to avoid impact with Mars.

Forty-two minutes after liftoff the spacecraft separated from the Agena D second stage. In the next half hour the four big solar panels had deployed and two sensors on the spacecraft had locked on the Sun, cancelling out all tumbling motion and maneuvering the craft so that all solar panels were correctly pointed.

With this accomplished, the Mariner IV began a search for the star Canopus about 2 a.m. EST Nov. 29. The lock on Canopus was completed about 7 a.m. the next day. This lock on Canopus was required to properly position the spacecraft. Canopus was selected because of its brightness and its specific location.

With one portion of the spacecraft facing the Sun and another portion always facing Canopus, Mariner IV was fixed in position for cruise.

#### ATTITUDE HELD FIRM

The position was held by a combination of attitude control systems that functioned to counter any tendency of the spacecraft to pitch, roll, or yaw. Gas jets, gyros, solar pressure vanes, jet vanes in the midcourse motor exhaust, solar and Canopus sensors, and associated electronics have all helped to keep Mariner in a stabilized attitude.

On Dec. 4, 1964 a midcourse maneuver was attempted, but was cancelled after the Canopus lock was lost. Canopus was reacquired by the star sensor after seven ground commands. The midcourse maneuver was successfully completed the next day. Purpose of the maneuver was to slightly alter the trajectory so that Mariner IV would pass closer to Mars.

On Dec. 6, 1964 telemetry data from the plasma probe, an instrument designed to measure solar wind, became unintelligible. The problem was traced to a resistor which opened. Later in the mission, after the spacecraft transmissions switched to a lower data rate, a large portion of the data from the plasma probe again became useful.

FIRM LOCK ON CANOPUS

Between Dec. 6 and 17, the Canopus lock was lost and reacquired several times apparently due to dust particles drifting in front of Canopus and reflecting flashes of sunlight back into the star sensor. A ground command sent Dec. 17 desensitized the sensor and has prevented this loss of lock from happening again.

A ground command sent Dec. 13 increased radio transmitter power from  $6\frac{1}{2}$  to  $10\frac{1}{2}$  watts by switching from one amplifier to another of a different type. The rate at which data was transmitted from the spacecraft was reduced automatically from  $33\frac{1}{3}$  to  $8\frac{1}{3}$  bits per second Jan. 3, 1965, because of the increasing distance between Mariner IV and Earth. At this time the plasma probe data became mostly recoverable.

LENS COVER REMOVED

On Feb. 11 and 12 a series of 12 commands were sent to Mariner IV to check out equipment to be used at encounter with Mars. A lens cover was dropped from the television camera and the scanning platform, carrying the camera and two Mars sensors, was preset in a position to be pointing at Mars during the fly-by.

The lens cover was removed at that time rather than near encounter to assure that the removal would not shake loose any dust particles that could distract the Canopus sensor at a crucial time.

ION CHAMBER EXPERIMENT FAILS

An unexpected event was announced March 3. The Geiger-Mueller tube portion of the ion chamber experiment failed. The tube counts the number of charged particles (radiation) encountered in a certain energy range. The chamber itself continued to function normally, measuring the total effect of radiation in the region of energy of electrons greater than a half-million electron volts and protons of greater than 10 million electron volts. However, on March 17 the ion chamber also ceased to return useful data.

This left five of the six interplanetary experiments functioning as Mariner IV passed the half-way point in its mission. By the 114th day of flight, March 21, Mariner IV had transmitted to Earth more than 160 million bits of engineering and scientific data from interplanetary space.

#### COMMUNICATIONS RECORD

On April 29 Mariner IV set a world space communications distance record as it reached a straight-line distance from Earth of 66 million miles.

In the course of its flight Mariner IV has detected 10 solar flares, eight of which were confirmed by ground observation posts. Total hits of cosmic dust micrometeoroids have topped 190.

### MARS ENCOUNTER

During the last hours before Mariner IV sweeps up to within 5700 miles of Mars, preparations will begin for the climatic phase of the spacecraft's mission. A series of events is scheduled to start about 10 hours before the spacecraft passes the planet. This 10-hour ground-to-space, space-to-ground checkout of instruments will be the project engineer's final stamp of approval on the instrument-laden package they have closely watched through the 228-day flight.

This will set the stage for photographing the planet and gathering other scientific information on the nature of Mars.

At 11:41 a.m. EDT, July 14, the Central Computer and Sequencer aboard Mariner IV will turn on the encounter science equipment and start the scan platform (with TV camera and two Mars sensors) searching for the planet. The television tape recorders will be warmed up, ready to turn on and record the pictures.

These commands to the spacecraft were engineered into the spacecraft before launch, and if their automatic proper execution cannot be verified on the ground a backup signal can be transmitted from the tracking station at Johannesburg, South Africa.

Throughout the day, the spacecraft will continue feeding back scientific and engineering information via the telemetry system.

The instruments on the spacecraft will scan the Martian skies, sweeping through 180 degrees nearly vertical to the direction of the spacecraft's motion. Sensitive sensors on the spacecraft will search for the target. Engineers at ground stations will stand by ready to send signals. They will watch their instruments for a verification that the search has been successful.

#### FIRST CONTACT WITH MARS

By 7:50 p.m. EDT, scientists will expect the spacecraft to make its first "sighting" contact with the planet. The telemetry system should then shift and begin sending only information from the scientific experiments. After a wait of 12 minutes, the time it takes for radio signals to reach Earth from 134 million miles away, these events should be verified at 8:02 at a ground station.

Aided and guided by the wide angle sensor, the narrow angle sensor on the spacecraft then takes over in the final minutes of the planet encounter, and at 8:20 p.m. EDT, the planet should be in full view and the 25-minute picture taking sequence will begin.

Immediately, the tape recorders begin collecting the detailed bits of information for the long process of composing 21 pictures of Mars.

Meanwhile, other experiments aboard Mariner IV will seek to detect and measure the planet's magnetic field, any trapped radiation belts such as Earth's Van Allen belts, the extent of cosmic dust (micrometeors) in the near-Mars region and solar wind around the planet.

If all goes well, the first two pictures will cover a part of the brightest of Martian deserts, Elysium, and an unusual maria region, Trivium Charontis. This region is of interest because it was only recently discovered to be a strong radar backscatterer -- a region that reflects radar waves as a mirror reflects light.

The television camera will then sweep southward across the desert Zephyria and into Mare Cimmerium. Farther south, over the desert Electis, an atmospheric haze which surrounds the polar cap at this time of the Martian year should be encountered.

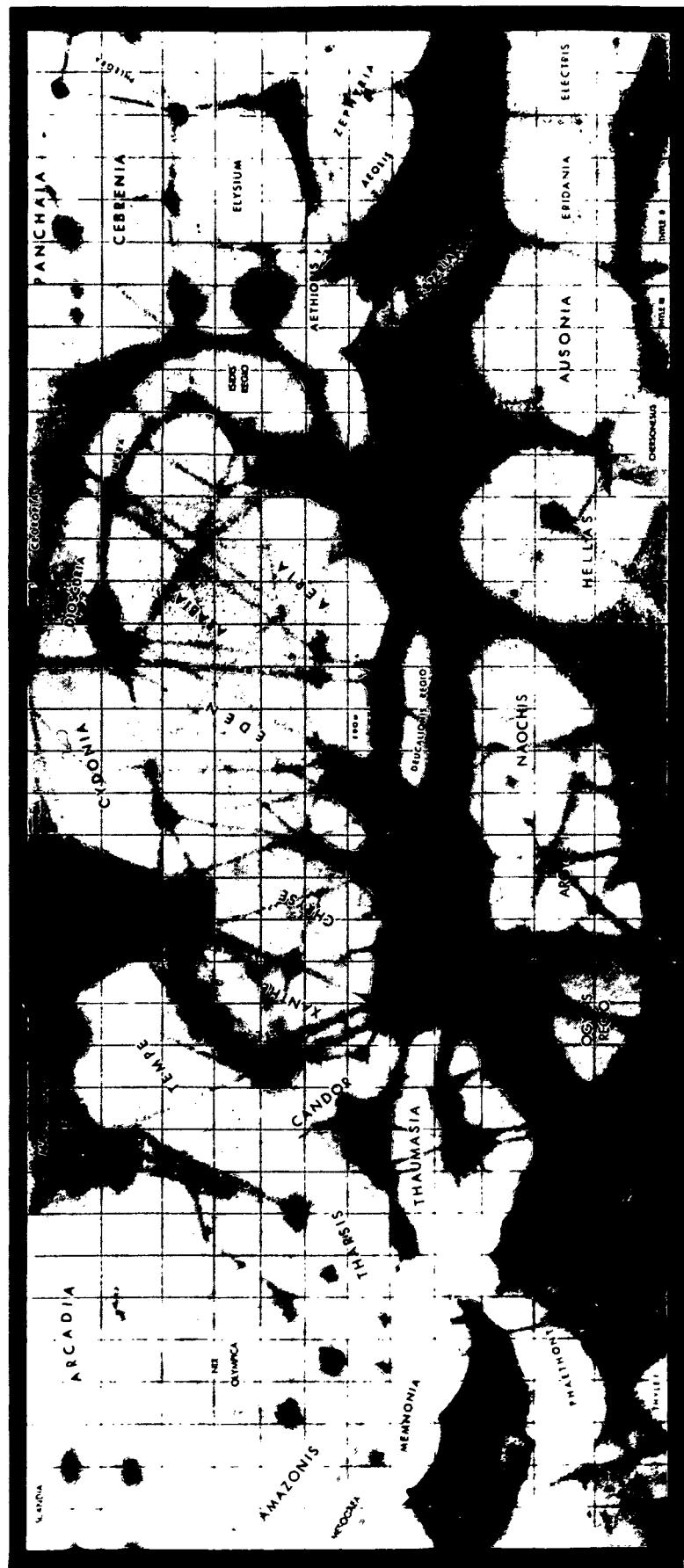


Chart of Mars

It is hoped that the camera will cut through this haze sufficiently to allow observation of the edge of the polar cap at 55 degrees south latitude. The TV scan will continue, now in a southeasterly direction, across the sunset terminator line south of Aonius Sinus in the polar cap.

The spacecraft will be at an altitude of about 7000 miles for the first pictures. The ground resolution will be best near the middle of the television pass when the camera will be pointed almost straight down at the planet. In this region, each picture will cover a surface area 120 by 120 miles, and it should be possible to resolve prominent surface markings as small as two miles across.

The picture taking sequence is scheduled to end at 8:45 p.m. EDT. Shortly after 9 p.m., Mariner will be at its closest distance to the planet.

### OCCULTATION EXPERIMENT

While scientists are eagerly studying the early indications of the planetary scientific experiments and the photographic mission, others will be absorbed with the occultation experiment, the receiving of Mariner radio signals that travel through the Martian atmosphere. Changes in frequency and strength of signal may help determine the density and depth of the Martian atmosphere.

About one hour after passing Mars, the spacecraft will fly behind Mars and remain obscured for about one hour. Just prior to entering this occultation region, and immediately after emerging, the spacecraft's radio signals will travel through the atmosphere and ionosphere, if any, of Mars of their way back to earth.

This will be the first time that a coherent radio transmission from an object in space will reach Earth after having traveled through the atmosphere of another planet.

The Martian atmosphere is thought to be much thinner than that of the Earth.

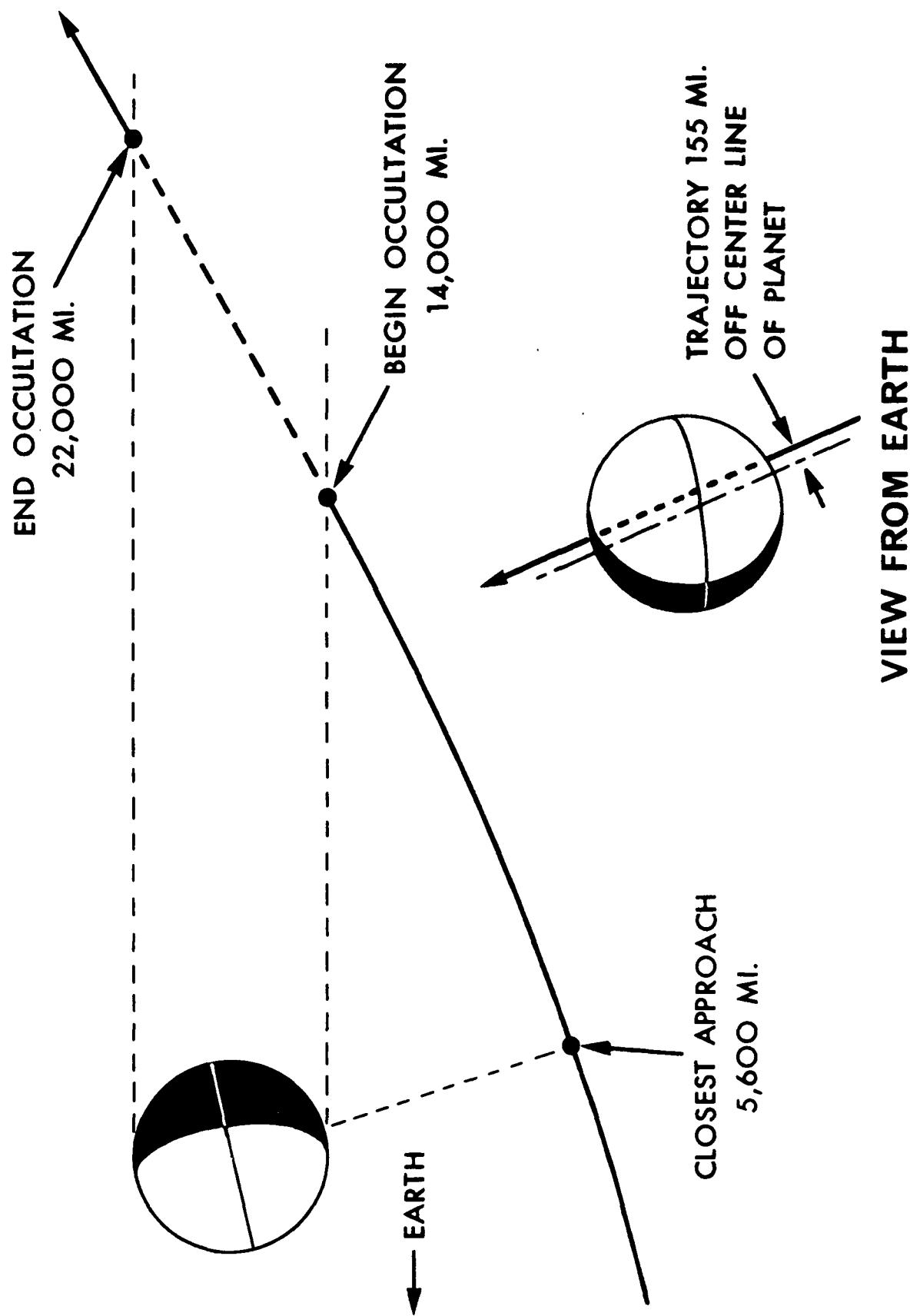
Knowledge of physical characteristics of Mars is essential for the design of capsules to land on the planet. Design of an entry capsule requires knowing the rate it will be slowed by atmospheric drag and whether or not a parachute system is sufficient or if some other means of slowing the capsule is required.

Detection of changes in the radio signal will provide a severe test of the Deep Space Network for the tracking of future spacecraft in the planetary regions.

Loss of radio signal is expected to occur at 10:12 pm EDT when the spacecraft enters the region behind Mars. Because of the 12 minutes required for the signal to reach Earth, this will be observed at the ground stations at 10:24. Resumption of radio signal reception is expected at 11:17, allowing for 53 minutes behind the planet and the 12-minute delay in receiving the signal.

## GEOOMETRY OF MARINER IV OCCULTATION BY MARS

- 19 -



### PLAYBACK OF PICTURES

With its tape recorder loaded with thousands of coded bits of Martian photographic details, Mariner will continue to probe deeper into space. NASA scientists will follow the voyage of the spacecraft for twelve hours before they call upon it to send back the pictures. Playback of the first picture is scheduled to begin at 8:41 a.m. EDT, July 15, and eight and one-half hours later the tape recorder should complete the transmission of the first television picture of Mars. Allowing 12 minutes for transmission over the 134 million miles, the first complete picture is expected at 5:28 p.m. EDT.

Between each picture transmission, the spacecraft will return 90 minutes of details on scientific experiments and engineering data. Thus, it will be 10 days before a full playback of all 21 pictures can be completed.

The Mariner spacecraft will continue to cruise through space sending back scientific and engineering data until it exceeds the communication range. Then, the mission will end but Mariner will continue in perpetual orbit around the Sun.

#### MARINER PROJECT TEAM

The National Aeronautics and Space Administration's programs for unmanned investigation of space are directed by Dr. Homer E. Newell, Associate Administrator for Space Science and Applications. Oran W. Nicks is the Director of OSSA's Lunar and Planetary Programs and Glenn A. Reiff is the Mariner Program Manager. Andrew Edwards is NASA's Mariner program engineer and Dr. Edward A. Gaugler is program scientist. Joseph B. Mahon is Agena Program Manager for OSSA's Launch Vehicle and Propulsion Programs.

NASA has assigned Mariner project management to its Jet Propulsion Laboratory, Pasadena, Calif., which is operated by the California Institute of Technology. Dr. William H. Pickering is the Director of JPL and Assistant Director Jack N. James heads JPL's lunar and planetary projects.

Dan Schneiderman is Mariner Project Manager. His two assistant project managers are Wilbur A. Collier and Theodore H. Parker. In a staff capacity, Norman R. Haynes is in charge of mission analysis and planning, and John S. Reuyl, launch constraints.

Richard K. Sloan is the Mariner Project Scientist.

The project is divided into four systems:

Spacecraft

Spaceflight Operations

Deep Space Network

Launch Vehicle

The first three systems are assigned to the Jet Propulsion Laboratory. The fourth is assigned to NASA's Lewis Research Center, Cleveland, for the Atlas-Agena launch vehicle. Dr. Abe Silverstein is the Director of Lewis Research Center. Launch operations for Lewis are directed by Goddard Space Flight Center Launch Operations at Cape Kennedy.

A few of the many key personnel in each of the systems are listed.

John R. Casani - Spacecraft System Manager

Allan Conrad - Spacecraft Project Engineer

Milton T. Goldfine - Spacecraft Operations Manager

James Maclay - Environmental Requirements Engineer

Richard A. Welnick - Quality Assurance Engineer

David E. Shaw - Spacecraft Program Engineer

A. Nash Williams - Spacecraft Launch Vehicle Integration

Herbert G. Trostle - Space Science

James N. Bryden - Spacecraft Telecommunications

James D. Acord - Spacecraft Guidance and Control

James H. Wilson - Spacecraft Engineering Mechanical  
Douglas S. Hess - Spacecraft Test Facilities  
Bruce Schmitz - Post-injection propulsion and pyrotechnics  
Wade G. Earle - Test Conductor, First flight spacecraft  
Max E. Goble - Test Conductor, Second flight spacecraft  
H. Holmes Weaver - Test Conductor, Test model spacecraft  
Thomas S. Bilbo Spaceflight Operations Systems Manager  
David W. Douglas - Spaceflight Operation Director  
Don B. Sparks - Facility Operations Manager  
Frank G. Curl - Data Processing Project Engineer  
Jay F. Helms - Communications  
Dr. Nichola A. Renzetti Deep Space Network System Manager  
Arthur T. Burke - Project Engineer  
Clarence A. Holritz - DSN Operations Manager  
Dr. S. Himmel Launch Vehicle System Manager  
C. Conger - Assistant Launch Vehicle System Manager  
R. Gedney - Project Engineer  
D. E. Forney - Chief of Agena Field Engineering Branch  
Robert H. Gray - Chief of Goddard Launch Operations  
Harold Zweigbaum - Manager of Atlas-Agena Launch Operations

MARINER SCIENTIFIC EXPERIMENTS

INSTRUMENT	INVESTIGATORS
Television subsystem -- obtain close-up pictures of planet surface	R. Leighton, B. Murray, R. Sharp, CIT; R. Sloan, J. Allen, JPL
Radio subsystem -- determine atmospheric properties of Mars on an occultation trajectory	A. Kliore, D. Cain, G. Levy, JPL; F. Drake, Cornell Univ; V. Eshleman, G. Fjeldbo, Stanford Univ.
Magnetometer -- measure magnitude and other characteristics of planetary and interplanetary magnetic fields	E. Smith, D. Jones, JPL; P. Coleman, UCLA; L. Davis, CIT
Cosmic dust detector -- measure momentum, distribution, density, and direction of cosmic dust	W. Alexander, C. McCracken, L. Secretan, O. Berg, GSFC; J. Boh, Temple Univ.
Ion chamber -- measure charged particle intensity and distribution of interplanetary space and in vicinity of Mars	H. Neher, CIT; H. Anderson, JPL
Trapped radiation detector -- measure intensity and direction of low energy particles	J. Van Allen, L. Frank S. Krimigis State University of Iowa
Cosmic Ray telescope -- measure direction and energy spectrum of protons and alpha particles	J. Simpson, J. O'Gallagher Univ. of Chicago
Plasma probe -- measure very low energy charged particle flux from the Sun	H. Bridge, A. Lazarus, MIT; C. Snyder, JPL
JPL -- Jet Propulsion Laboratory CIT -- California Institute of Technology GSFC -- Goddard Space Flight Center MIT -- Massachusetts of Technology	

MARINER IV LOG

EVENT	DATE & TIME (PST)	REMARKS
<u>November 28, 1964</u>		
Liftoff	6:22:01 AM	
Atlas/Agena Separation	6:27:20 AM	
Shroud Ejection	6:27:23 AM	
1st Agena Ignition	6:28 AM	
1st Agena Cutoff	6:30 AM	
2nd Agena Ignition	7:02 AM	
2nd Agena Cutoff	7:04:27 AM	Injection velocity: 25,598 MPH Desired velocity: 25,591 MPH Injection altitude: 122.8 MI Earth-Mars distance: 127.7 Million MI
Enter Earth's Shadow	7:05:51 AM	
Mariner/Agena Separation	7:07:10 AM	
Solar Panels Deployed	7:15:05 AM	Start Sun acquisition
Exit Earth's Shadow	7:17:35 AM	
Sun Acquisition Complete	7:31 AM	
Start Canopus Search	10:59 PM	Automatic command from CC&S
Alderamin Acquired	11:07 PM	Momentary stop at Markab (51°)
<u>November 29, 1964</u>		
Lost Lock on Alderamin	5:13 AM	Automatic search
Lock on Regulus	5:29 AM	107° Roll
<u>November 30, 1964</u>		
DC-21	1:14 AM	Command roll search (from Goldstone)
Lock on Naos	1:21 AM	60° Roll
DC-21	2:45 AM	Search command (from Goldstone)
Lock on 3-star cluster	2:46 AM	7° Roll

Mariner IV Log (Cont'd)

EVENT	DATE & TIME (PST)	REMARKS
<u>November 30, (Cont'd)</u>		
DC-21	2:58 AM	Search command (from Goldstone)
Canopus Acquisition	3:00 AM	15° Roll (293° total roll from start)
<u>December 4, 1964</u>		
QC1-1	5:05 AM	Stored pitch command (-43.94°)
QC1-2	5:10 AM	Stored roll command (+156.24°)
QC1-3	5:15 AM	Stored motorburn command (20.18 sec)
DC-29	5:45 AM	Arm propulsion pyros
DC-14	6:05 AM	Remove maneuver inhibit
DC-27	6:35 AM	Initiate maneuver sequence
Roll Condition Observed	6:36 AM	
DC-13	6:47:13 AM	Inhibit maneuver sequence
Lock on Unknown Object	6:51:53 AM	Approximate 90° Roll
DC-21	7:22 AM	Search command
Lock on Unknown Object	7:26 AM	
DC-21	7:32 AM	Search command
Lock on Unknown Object	7:36:12 AM	
DC-21	8:02 AM	Search command
Lock on Unknown Object	8:06:39 AM	
Midcourse Maneuver Attempt Scrubbed	8:25 AM	
DC-21	2:40 PM	Search command
Lock on Unknown Object	2:44 PM	
DC-21	3:04 PM	Search command sent in order to pass star cluster
DC-21	3:05:01 PM	Search command sent in order to pass star cluster
DC-21	3:05:59 PM	Search command sent in order to pass star cluster
Lock on Star Regulus	3:25:08 PM	
DC-21	3:40 PM	Search command

Mariner IV Log (Cont'd)

EVENT	DATE & TIME (PST)	REMARKS
<u>December 4, (Cont'd)</u>		
Lock on Star Naos	3:48:52 PM	
DC-21	3:57 PM	Search command sent in order to pass G-VEL
DC-21	3:58 PM	Search command sent in order to pass G-VEL
Canopus Acquisition	3:59:22 PM	
2nd Midcourse Attempt	<u>December 5, 1964</u>	
QC1-1	5:05 AM	Stored pitch command (-39.2°)
QC1-2	5:10 AM	Stored roll command (+156.08°)
QC1-3	5:15 AM	Stored motor burn command (20.06 sec)
DC-29	5:45 AM	Arm propulsion pyros
DC-14	6:05 AM	Remove maneuver inhibit
DC-27	6:25 AM	Initiate maneuver
Start Pitch	7:25:08 AM	
Stop Pitch	7:28:54 AM	
Start Roll	7:47:10 AM	
Stop Roll	8:01:19 AM	
Motor Ignition	8:09:09 AM	
Motor cutoff	8:09:29.06 AM	Burn time nominal
Start Sun Acquisition	8:15:11 AM	Automatic from CC&S
Complete Sun Acquisition	8:21:07 AM	
Start Canopus Search	8:21:07 AM	Automatic from CC&S
Lock on Star G-VEL	8:44:39 AM	Rolled passed Regulus & Naos
DC-21	8:52:00 AM	Search command
Acquired Canopus	8:54:57 AM	
<u>December 7, 1964</u>		
Lost Canopus Lock	4:30 AM	
Plasma Probe Failure	4:30 AM	Time approximate - not connected with loss of Canopus lock
Acquired G-VEL	5:15 AM	

Mariner IV Log (Cont'd)

EVENT	DATE & TIME (PST)	REMARKS
DC-7	<u>December 13, 1964</u> 6:09 AM	Switch from cavity amplifier to traveling wave amplifier - changed transmitter output from 6 1/2 watts to 10 1/2 watts
DC-21	<u>December 17, 1964</u> 8:00 AM	Canopus search command
Canopus Acquisition	8:03:02 AM	
DC-15	9:30:00 AM	Inhibits Canopus sensor gates preventing gyro turn-on when dust particle passes in sensor view
~ Bit Rate Change (33 1/3 Bits/Sec to 8 1/3 Bits/Sec)	<u>January 3, 1965</u> 8:59:56 AM	Automatic from CC&S
Direct Commands	<u>February 11, 1965</u>	
DC-3	7:29:29 PM	Switches data encoder to all science telemetry (Mode III)
DC-2	7:36:13 PM	Switches data encoder back to cruise engineering and science telemetry
DC-26	7:53:15 PM	Turns off all science and battery charger, power boost mode on.
DC-2	8:15:51 PM	Turn on cruise science
DC-28	8:32:39 PM	Turn battery charger on -- Normal cruise condition again
DC-25	10:54:43 PM	Turn on encounter science, warm up tape recorder (no pictures recorded) start scan motor, remove scan cover
DC-24	<u>February 12, 1965</u> 12:59:23 AM	Stop scan platform
DC-28	1:30:56 AM	Turn off tape recorder

EVENT	DATE & TIME (PST)	REMARKS
<u>February 12, 1965 (cont'd)</u>		
DC-3	1:30:56 AM	Switch encoder to all science telemetry (Mode III)
DC-2	2:21:20 AM	Switch encoder to cruise engineering and science telemetry (Mode II)
DC-26	2:27:08 AM	Turn off all science and battery charger, power boost mode on
DC-2	2:49:35 AM	Turn on cruise science
The spacecraft mode of operation is now: Cruise science and engineering telemetry on; power boost mode on; scan cover removed; scan platform in nominal position for encounter; Canopus sensor gates off. Total of 42 ground commands to spacecraft so far.		
<u>February 27, 1965</u>		
MT-1	9:02 AM	Command from CC&S to change Canopus sensor cone angle
<u>March 3, 1965</u>		
70% data recovery from plasma probe	announced	Resistor failure compensated for in calibrations
Failure of Geiger Mueller tube associated with ion chamber	announced	Data received but not understood
<u>March 5, 1965</u>		
MT-5	5:02:40 AM	CC&S command to switch transmitter from Omni to high-gain antenna
Signal level rise from -164 DBM to -148.5 DBM	5:04:20 AM	Signal strength increased 40 times
<u>March 17, 1965</u>		
Failure of Ion Chamber		Reason for failure unknown - occurred during Jo'burg view period. Jo'burg not tracking because of planned RA-9 launch 3/21.

EVENT	DATE & TIME (PST)	REMARKS
	<u>April 2, 1965</u>	
MT-2	6:24 AM	Command from CC&S to change Canopus sensor cone angle.
	<u>May 7, 1965</u>	
MT-3	7:27 AM (PDT)	Command from CC&S to change Canopus sensor cone angle.
	<u>June 14, 1965</u>	
MT-4	8:40 AM (PDT)	Command from CC&S to change Canopus sensor cone angle.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

TELS. WO 2-4155  
WO 3-6925

**FOR RELEASE: FRIDAY A.M.**  
**July 2, 1965**

RELEASE NO: 65-215

MARINER IV  
WITHIN TWO WEEKS  
OF MARS FLYBY

The National Aeronautics and Space Administration's Mariner IV spacecraft, now in its 216th day of flight, must travel only 12 more days before it passes within, 5,700 miles of the planet Mars.

Mariner will take and record up to 21 pictures of Mars on July 14 for playback to Earth beginning the following day and continuing for several weeks.

Mariner IV position reports for the period July 2 - 14 follow (EDT):

<u>Date</u>	<u>Miles from Earth</u>	<u>Miles from Mars</u>	<u>Total Miles Travelled In Space</u>
July 2			
9 a.m.	123,394,940	2,969,022	310,900,000
9 p.m.	123,841,000	2,909,482	
July 3			
9 a.m.	124,285,590	2,730,970	312,100,000
9 p.m.	124,731,740	2,612,044	
July 4			
9 a.m.	125,176,410	2,493,178	313,200,000
9 p.m.	125,620,590	2,374,368	
July 5			
9 a.m.	126,064,300	2,255,612	314,300,000
9 p.m.	126,507,500	2,136,907	

July 6			
9 a.m.	126,950,210	2,018,246	315,500,000
9 p.m.	127,392,400	1,899,628	
July 7			
9 a.m.	127,834,408	1,781,048	316,600,000
9 p.m.	128,275,240	1,662,503	
July 8			
9 a.m.	128,715,870	1,543,989	317,800,000
9 p.m.	129,155,970	1,425,501	
July 9			
9 a.m.	129,595,530	1,307,037	318,900,000
9 p.m.	130,036,080	1,187,572	
July 10			
9 a.m.	130,474,570	1,069,131	320,700,000
9 p.m.	130,912,510	950,697	
July 11			
9 a.m.	131,349,910	832,262	321,900,000
9 p.m.	131,786,750	713,820	
July 12			
9 a.m.	132,233,060	595,357	322,800,000
9 p.m.	132,658,840	476,857	
July 13			
9 a.m.	133,094,110	358,291	324,000,000
9 p.m.	133,528,940	239,600	
July 14			
9 a.m.	133,963,540	120,638	325,100,000
9 p.m.	134,400,570	5,493	

-end-

RELEASE NO: 65-204

**FOR RELEASE:** IMMEDIATE, TUESDAY  
June 22, 1965Also released at  
JPL, Pasadena, Calif.

MARINER IV TO BEGIN

MARS PHOTOGRAPHY

AT 8 P.M. EDT JULY 14

The National Aeronautics and Space Administration's Mariner IV is scheduled to begin taking close-up pictures of Mars shortly after 8 p.m. EDT July 14.

During the 25-minute picture-taking period which follows, the spacecraft is expected to take 21 pictures and record the pictures on magnetic tape.

The pictures will be telemetered back to Earth bit by bit over the following 10 days.

Final pictures will be taken near or in the shadowed half of Mars. It is not possible now to determine if the final frames will be usable.

NASA plans to position the television camera a few hours prior to encounter by stopping the scan platform at a predetermined angle. If this is successful, the first two pictures will cover a part of the brightest of Mars' deserts, Elysium, and an unusual maria region, Trivium Charontis. This region was discovered recently to be a strong radar backscatterer; that is, the region reflects radar waves as a mirror reflects light.

After the first two frames, the television camera will sweep southward across the desert Zephyria and into Mare Cimmerium. Farther south, over the desert Electris, the atmospheric haze which surrounds the polar cap at this time of the Martian year will be encountered. It is hoped that the camera will cut through this haze sufficiently to allow observation of the edge of the polar cap at 55 degrees south latitude.

The TV scan will continue, now in a southeasterly direction, across the sunset terminator south of Aonius Sinus in the polar cap.

The spacecraft will be 7,000 miles above Mars for the first picture, moving southeastward at 180 degrees east longitude and 40 degrees south latitude. The ground resolution will be best near the middle of the television pass where the camera will be pointed almost straight down. In this region each picture will cover a surface area 120 by 120 miles and it will be possible to resolve prominent surface markings as small as two miles across.

1  
MARINER IV ENCOUNTER SEQUENCE AT MARS

All times noted in the following table are Pacific Daylight Time. MT commands are issued by Mariner IV's on-board central computer and sequencer. MT means master timer. These commands were pre-programmed into the CC&S prior to launch last November 28. DC commands are transmitted by the space communication stations of the Deep Space Network. DC means direct commands. Mariner's command subsystem can accept 29 different direct commands.

Six stations of the Deep Space Network will be in operation during the Mariner IV encounter with Mars. Primary stations are located near Johannesburg, South Africa; Canberra, Australia; and at Goldstone, California (Pioneer Site at Goldstone). Backup stations are at Woomera, Australia; Madrid, Spain; and at the Echo Site at Goldstone.

<u>TIME (PDT)</u>	<u>EVENT</u>	<u>REMARKS</u>
7/14/65 8:41 am	MT-7 (on-board command)	CC&S command turns on encounter science; starts TV shutter sequencing; starts scan platform searching for planet; turns on tape recorder power (tape not rolling and not recording); telemetry remains in cruise mode (engineering and cruise science data).
8:53 am		MT-7 verified on Earth. Johannesburg tracking. (If not verified, ground command DC-25 transmitted at backup.)
10:53 am	DC-24 (ground command)	Transmitted from Johannesburg to pre-position scan platform.
11:05 am		Spacecraft receives DC-24.
11:17 am		Spacecraft execution of DC-24 verified on Earth. (If platform does not stop scanning, await wide angle acquisition.)
4:50 pm	WAA	Wide-angle acquisition. Wide-angle sensor on scan platform sees limb of planet and positions scan platform at proper angle if not already pre-positioned by DC-24. Telemetry mode changed to science data and engineering information on operation of TV subsystem.
5:02 pm		WAA verified on Earth. Goldstone tracking. (If not verified, DC-24 is transmitted as backup.)
5:13 pm	DC-16	Transmitted from Goldstone as narrow-angle acquisition backup.
5:20 pm	NAA	Narrow-angle acquisition. Narrow-angle sensor on scan platform sees planet; starts tape rolling and picture recording.
5:25 pm		DC-16 received at spacecraft.
5:32 pm		NAA verified on Earth. Goldstone tracking.
5:45 pm		Finish recording pictures. Tape recorder off. (It may be decided to transmit DC-26 from Goldstone at 5:38 pm to backup tape recorder turn-off following picture recording. The command would be received at the spacecraft at 5:38 pm. DC-26 would be followed at 5:39 pm with DC-2 to turn on cruise science and switch telemetry to mix of cruise science and engineering data. DC-2 would be received at the spacecraft at 5:41 pm.)

<u>TIME (PDT)</u>	<u>EVENT</u>	<u>REMARKS</u>
6:02:54 pm	Point of closest approach	Spacecraft distance from Mars, approximately 5,700 miles. Spacecraft distance from Earth, about 134 million miles. Goldstone tracking.
7:12 pm	Enter occultation	Radio signal from spacecraft cut off when Mars is between spacecraft and Earth.
7:24 pm		Loss of radio signal observed on Earth. Goldstone and Canberra tracking.
8:05 pm	Exit occultation	Spacecraft again in sight of Earth after 52 minutes, 32 seconds behind Mars.
8:17 pm		Resumption of radio signal reception at Goldstone and Canberra.
10:01 pm	MT-8	CC&S command turns off encounter science.
10:13 pm		MT-8 verified on Earth. Goldstone and Canberra tracking.
7/15/65		
4:41 am	MT-9	CC&S command starts tape recorder in playback operation and switches telemetry to science playback mode.
4:53 am		MT-9 verified on Earth. Canberra and Johannesburg tracking.
5:41 am	Picture Playback	Spacecraft starts playback of first picture. Playback of each picture takes 8 hours, 35 minutes.
5:53 am		Johannesburg and Madrid start receiving and recording transmission of first picture.
2:16 pm		Spacecraft completes transmission of first picture. Transmits other recorded science data for two hours, then begins transmission of second picture.
2:28 pm		Complete picture received on Earth. Primary stations at Johannesburg and Goldstone record overlapping picture data. Backup station at Madrid records entire first picture.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

TELS. WO 2-4155  
WO 3-6925

### MARINER IV LOG

EVENT	DATE & TIME (PST)	REMARKS
<u>November 28, 1964</u>		
Liftoff	6:22:01 AM	
Atlas/Agena Separation	6:27:20 AM	
Shroud Ejection	6:27:23 AM	
1st Agena Ignition	6:28 AM	
1st Agena Cutoff	6:30 AM	
2nd Agena Ignition	7:02 AM	
2nd Agena Cutoff	7:04:27 AM	Injection velocity: 25,598 MPH Desired velocity: 25,591 MPH Injection altitude: 122.8 MI Earth-Mars distance: 127.7 Million MI
Enter Earth's Shadow	7:05:51 AM	
Mariner/Agena Separation	7:07:10 AM	
Solar Panels Deployed	7:15:05 AM	Start Sun acquisition
Exit Earth's Shadow	7:17:35 AM	
Sun Acquisition Complete	7:31 AM	
Start Canopus Search	10:59 PM	Automatic command from CC&S
Alderamin Acquired	11:07 PM	Momentary stop at Markab (51°)
<u>November 29, 1964</u>		
Lost Lock on Alderamin	5:13 AM	Automatic search
Lock on Regulus	5:29 AM	107° Roll
<u>November 30, 1964</u>		
DC-21	1:14 AM	Command roll search (from Goldstone)
Lock on Naos	1:21 AM	60° Roll
DC-21	2:45 AM	Search command (from Goldstone)
Lock on 3-star cluster	2:46 AM	7° Roll

EVENT	DATE & TIME (PST)	REMARKS
<u>November 30, (Cont'd)</u>		
DC-21	2:58 AM	Search command (from Goldstone)
Canopus Acquisition	3:00 AM	15° Roll (293° total roll from start)
<u>December 4, 1964</u>		
QC1-1	5:05 AM	Stored pitch command (-43.94°)
QC1-2	5:10 AM	Stored roll command (+156.24°)
QC1-3	5:15 AM	Stored motorburn command (20.18 sec)
DC-29	5:45 AM	Arm propulsion pyros
DC-14	6:05 AM	Remove maneuver inhibit
DC-27	6:35 AM	Initiate maneuver sequence
Roll Condition Observed	6:36 AM	
DC-13	6:47:13 AM	Inhibit maneuver sequence
Lock on Unknown Object	6:51:53 AM	Approximate 90° Roll
DC-21	7:22 AM	Search command
Lock on Unknown Object	7:26 AM	
DC-21	7:32 AM	Search command
Lock on Unknown Object	7:36:12 AM	
DC-21	8:02 AM	Search command
Lock on Unknown Object	8:06:39 AM	
Midcourse Maneuver Attempt Scrubbed	8:25 AM	
DC-21	2:40 PM	Search command
Lock on Unknown Object	2:44 PM	
DC-21	3:04 PM	Search command sent in order to pass star cluster
DC-21	3:05:01 PM	Search command sent in order to pass star cluster
DC-21	3:05:59 PM	Search command sent in order to pass star cluster
Lock on Star Regulus	3:25:08 PM	
DC-21	3:40 PM	Search command

EVENT	DATE & TIME (PST)		REMARKS
<u>December 4, (Cont'd)</u>			
Lock on Star Naos		3:48:52 PM	
DC-21	3:57	PM	Search command sent in order to pass G-VEL
DC-21	3:58	PM	Search command sent in order to pass G-VEL
Canopus Acquisition	3:59:22 PM		
2nd Midcourse Attempt	<u>December 5, 1964</u>		
QC1-1	5:05	AM	Stored pitch command (-39.2°)
QC1-2	5:10	AM	Stored roll command (+156.08°)
QC1-3	5:15	AM	Stored motor burn command (20.06 sec)
DC-29	5:45	AM	Arm propulsion pyros
DC-14	6:05	AM	Remove maneuver inhibit
DC-27	6:25	AM	Initiate maneuver
Start Pitch	7:25:08	AM	
Stop Pitch	7:28:54	AM	
Start Roll	7:47:10	AM	
Stop Roll	8:01:19	AM	
Motor Ignition	8:09:09	AM	
Motor cutoff	8:09:29.06	AM	Burn time nominal
Start Sun Acquisition	8:15:11	AM	Automatic from CC&S
Complete Sun Acquisition	8:21:07	AM	
Start Canopus Search	8:21:07	AM	Automatic from CC&S
Lock on Star G-VEL	8:44:39	AM	Rolled passed Regulus & Naos
DC-21	8:52:00	AM	Search command
Acquired Canopus	8:54:57	AM	
<u>December 7, 1964</u>			
Lost Canopus Lock	4:30	AM	
Plasma Probe Failure	4:30	AM	Time approximate - not connected with loss of Canopus lock
Acquired G-VEL	5:15	AM	

EVENT	DATE & TIME (PST)	REMARKS
	<u>December 13, 1964</u>	
DC-7	6:09 AM	Switch from cavity amplifier to traveling wave amplifier - changed transmitter output from 6 1/2 watts to 10 1/2 watts
	<u>December 17, 1964</u>	
DC-21	8:00 AM	Canopus search command
Canopus Acquisition	8:03:02 AM	
DC-15	9:30:00 AM	Inhibits Canopus sensor gates preventing gyro turn-on when dust particle passes in sensor view
	<u>January 3, 1965</u>	
Bit Rate Change (33 1/3 Bits/Sec to 8 1/3 Bits/Sec)	8:59:56 AM	Automatic from CC&S
	<u>February 11, 1965</u>	
Direct Commands		
DC-3	7:29:29 PM	Switches data encoder to all science telemetry (Mode III)
DC-2	7:36:13 PM	Switches data encoder back to cruise engineering and science telemetry
DC-26	7:53:15 PM	Turns off all science and battery charger, power boost mode on.
DC-2	8:15:51 PM	Turn on cruise science
DC-28	8:32:39 PM	Turn battery charger on -- Normal cruise condition again
DC-25	10:54:43 PM	Turn on encounter science, warm up tape recorder (no pictures recorded) start scan motor, remove scan cover
	<u>February 12, 1965</u>	
DC-24	12:59:23 AM	Stop scan platform
DC-28	1:30:56 AM	Turn off tape recorder

EVENT	DATE & TIME (PST)	REMARKS
<u>February 12, 1965 (cont'd)</u>		
DC-3	1:30:56 AM	Switch encoder to all science telemetry (Mode III)
DC-2	2:21:20 AM	Switch encoder to cruise engineering and science telemetry (Mode II)
DC-26	2:27:08 AM	Turn off all science and battery charger, power boost mode on
DC-2	2:49:35 AM	Turn on cruise science
The spacecraft mode of operation is now: Cruise science and engineering telemetry on; power boost mode on; scan cover removed; scan platform in nominal position for encounter; Canopus sensor gates off. Total of 42 ground commands to spacecraft so far.		
<u>February 27, 1965</u>		
MT-1	9:02 AM	Command from CC&S to change Canopus sensor cone angle
<u>March 3, 1965</u>		
70% data recovery from plasma probe	announced	Resistor failure compensated for in calibrations
Failure of Geiger Mueller tube associated with ion chamber	announced	Data received but not understood
<u>March 5, 1965</u>		
MT-5	5:02:40 AM	CC&S command to switch transmitter from Omni to high-gain antenna
Signal level rise from -164 DBM to -148.5 DBM	5:04:20 AM	Signal strength increased 40 times
<u>March 17, 1965</u>		
Failure of Ion Chamber		Reason for failure unknown - occurred during Jo'burg view period. Jo'burg not tracking because of planned RA-9 launch 3/21.

EVENT	DATE & TIME (PST)	REMARKS
	<u>April 2, 1965</u>	
MT-2	6:24 AM	Command from CC&S to change Canopus sensor cone angle.
	<u>May 7, 1965</u>	
MT-3	7:27 AM (PDT)	Command from CC&S to change Canopus sensor cone angle.
	<u>June 14, 1965</u>	
MT-4	8:40 AM (PDT)	Command from CC&S to change Canopus sensor cone angle.

June 17, 1965

**NOTE TO EDITORS:**

A press briefing on the Mariner IV mission to Mars will be held in the auditorium of the Jet Propulsion Laboratory, Pasadena, Calif., at 9:30 a.m. PDT, June 22, 1965.

The briefing will be made available to news media representatives in the National Aeronautics and Space Administration's auditorium, Federal Office Building No. 6, 400 Maryland Avenue, S.W., Washington, D.C., at 12:30 p.m. EDT, by a telephone line from JPL.

The briefing will be to review events of Mariner's interplanetary flight and to discuss operation of the spacecraft and its scientific experiments during the encounter with Mars July 14.

**Participants will include:**

Dr. William H. Pickering  
Director of JPL

Glenn A. Reiff  
NASA Mariner Program Manager

Dan Schneiderman  
JPL, Project Manager

Richard K. Sloan  
Mariner Project Scientist, JPL

Dr. R. B. Leighton  
California Institute of Technology  
Television Scientific Investigator

Dr. A. J. Kliore  
JPL, Occultation Scientific Experimentor

Dr. Nichola A. Renzetti  
Deep Space Network System Manager

After a brief statement of each of the participants, there will be a question and answer session with facilities available for news media representatives in Washington to question the participants in Pasadena.

# NEWS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

TELS. WO 2-4155  
WO 3-6925

**FOR RELEASE: SUNDAY**  
June 20, 1965

RELEASE NO: 65-198

FAINT RADIO SIGNALS  
PROVIDE FIRM LOCK  
ON MARINER MISSION

After 204 days of the longest space exploration mission in history, the National Aeronautics and Space Administration Mariner IV's electronic signals to Earth today are arriving with a strength of slightly less than one-billionth-of-one billionth of a watt.

NASA engineers calculate the power of the received radio signals from the Mars-bound Mariner, now 113 million miles away, at about .000000000000000001 watt (18 zeros are correct).

When beamed toward Earth from the Mariner antenna, the signal strength is 10 watts.

Targets of Mariner's continuous radio reports from interplanetary space are the 85-foot diameter antennas of the NASA Jet Propulsion Laboratory Deep Space Network. Three DSN stations are located around the globe about 120 degrees apart.

Super-sensitive receivers, coupled with the big DSN antennas, are able to home in on the Mariner signal, as faint as it is, and amplify it for telemetry processing, recording and relay, via a ground communications system, to JPL's mission control center in Pasadena, Calif.

The three DSN stations, working together, keep a 24-hour-a-day watch on Mariner IV and stand ready to transmit commands to the spacecraft should they be required. Each station receives scientific and engineering information from Mariner's signals for about nine hours every day.

Counting the two to three hours it takes to prepare a station for a Mariner pass, about nine hours of tracking and monitoring, and another hour or so to close down, each DSN station has been devoting some 13 to 14 hours daily to the Mariner mission. Engineers and technicians work in four shifts.

As the Earth rotates on its axis, the DSN big dish antennas move slowly from west to east, finally losing contact with Mariner IV near the horizon at each site.

While the antenna at Goldstone, Calif., is moving out of earshot, the station at Tidbinbilla, near Canberra, Australia, is picking up Mariner's signal. From Tidbinbilla, tracking and monitoring is handed over to the station at Johannesburg, South Africa, and then back again to Goldstone.

The JPL Space Flight Operations Facility (SFOF) has been operating on a 24-hour basis from the time that Mariner IV was launched, Nov. 28, 1964. Since that day, four American astronauts have orbited the Earth, two Ranger spacecraft have photographed the Moon and 10 NASA satellites have been put in orbit.

Mariner will fly another four weeks before passing within 6,000 miles of Mars July 14 for close-up measurements and it has many weeks to go beyond Mars for transmission of television pictures and other scientific data back to Earth.

JPL scientists and engineers have almost immediate access at the SFOF to Mariner's constant flow of messages -- about 100,000 each day -- that include interplanetary measurements made by scientific instruments aboard and other data indicating performance of the spacecraft itself. It is at the SFOF that data is analyzed and decisions are made to send commands to Mariner.

Latest event, monitored in near real-time, was a command issued by Mariner's on-board Central Computer and Sequencer to the Canopus star tracker June 14.

It is necessary to keep this star sensor pointed at Canopus so that the spacecraft will be properly aligned and stabilized in attitude.

The June 14 command to the star sensor was made to compensate for the changing relationship between the space-craft, the Sun and Canopus. The command electronically altered the "look angle" of the sensor so that Canopus will remain in view throughout the encounter sequence next month and beyond.

The Johannesburg station was tracking Mariner when the "update" occurred right on time at 11:40 a.m. EDT. It was about 10 minutes later that Mariner's keepers in Pasadena, learned that the command was issued and was acted upon properly. Because of the communications distance on that day, Mariner's radio signal needed nearly 10 minutes to reach the big antenna in Johannesburg.

As Mariner IV gets closer to Mars and into the critical encounter sequence, activity will heighten at SFOF and at the tracking stations. During the week prior to Mariner's July 14 planet fly-by, the three stations now tracking Mariner will follow it from horizon to horizon, increasing the viewing time up to about 12 hours a day for each station and hence expanding the overlapping coverage. Three additional stations of the DSN are expected to be "on line"--at Woomera, Australia; Madrid, Spain; and a second station at Goldstone.

Before any one of the tracking stations can "lock on" to Mariner's signal, technicians must know where to point the antenna when their turn comes around.

This information is supplied by the radio signal itself. As tracking is receiving at one of the stations and is relayed to SFOF it reveals to trajectory experts Mariner's exact location in space and its velocities relative to the Sun, Earth and Mars.

With the aid of computers of the SFOF data processing center, pass predictions are made and transmitted to the station waiting to lock up the signal. These predictions tell the station personnel where to expect Mariner to appear in the sky as it clears the horizon and at what radio frequency to tune the receiver.

Accurate tracking of Mariner IV is based on the Doppler shift of its radio signal, or the apparent change in frequency of the signal as the spacecraft moves farther away from Earth. Two-way Doppler used by the DSN in tracking lunar and planetary spacecraft, utilizes a signal transmitted from the station to the spacecraft receiver-transmitter where it is converted to a new frequency in an exact ratio with the ground frequency and then retransmitted to Earth. Since the frequency of the signal sent from the ground can be determined with great precision, the resulting Doppler information and velocity calculations are very accurate.

Transmitter power at each of the DSN stations is 10,000 watts. The transmitter is used both for two-way Doppler tracking and for sending commands to Mariner IV. The space-craft has received and acted upon 42 commands from Earth since launch. Others may be transmitted during the encounter phase of the mission.

The two-way Doppler technique is the key to one of Mariner IV's planetary investigations--the occultation experiment. About an hour after the point of closest approach the spacecraft will pass behind Mars as viewed from Earth. The Doppler effect upon the radio signal as it penetrates the Martian atmosphere may permit scientists to determine the density and scale height of the atmosphere.

The Mariner IV camera system is expected to take and record as many as 21 black-and-white still pictures of the planet's surface for later playback to Earth beginning about 10 hours after the fly-by.

Because of the data rate possible at the Earth-Mars distance--8 1/3 bits per second--it will take more than eight hours to transmit each picture which contains about 250,000 bits of information. Plans to play back each picture twice will require nearly three weeks for completion.

Since the picture data will be received in binary form--ones and zeroes which form values representing light intensity from white to black--it is possible to receive part of a picture at Johannesburg or Madrid and another part at Goldstone, losing nothing in the transfer. The time-coded digital information can be matched at JPL where it will be converted into a photograph of the surface of Mars. The conversion process, involving computer programs and specialized equipment, may take several days.

On April 29, 1965, Mariner IV established a new space communication distance record of 66 million miles. The mark will more than double at encounter.

Mariner project officials do not anticipate a break in the communications from Mariner to Earth for several months after it encounters Mars. It is probable that Mariner IV will continue broadcasting for a long time as it orbits the Sun but out of range of the Earth.

Mariner IV position reports for the period June 17 through June 23 follow (all time Eastern Daylight):

<u>Date</u>	<u>Earth-Mariner Distance (miles)</u>	<u>Mariner-Mars Distance (miles)</u>	<u>Total Distance Traveled (miles)</u>
<u>6/17</u>			
9 am	109,864,940	6,592,523	293,600,000
9 pm	110,318,940	6,469,492	

6/18

9 am	110,772,820	6,346,590	294,700,000
9 pm	111,226,560	6,224,022	

6/19

9 am	111,680,170	6,101,572	295,900,000
9 pm	112,133,630	5,979,307	

6/20

9 am	112,586,940	5,857,220	297,100,000
9 pm	113,040,090	5,735,309	

6/21

9 am	113,493,070	5,613,567	298,200,000
9 pm	113,945,587	5,491,988	

6/22

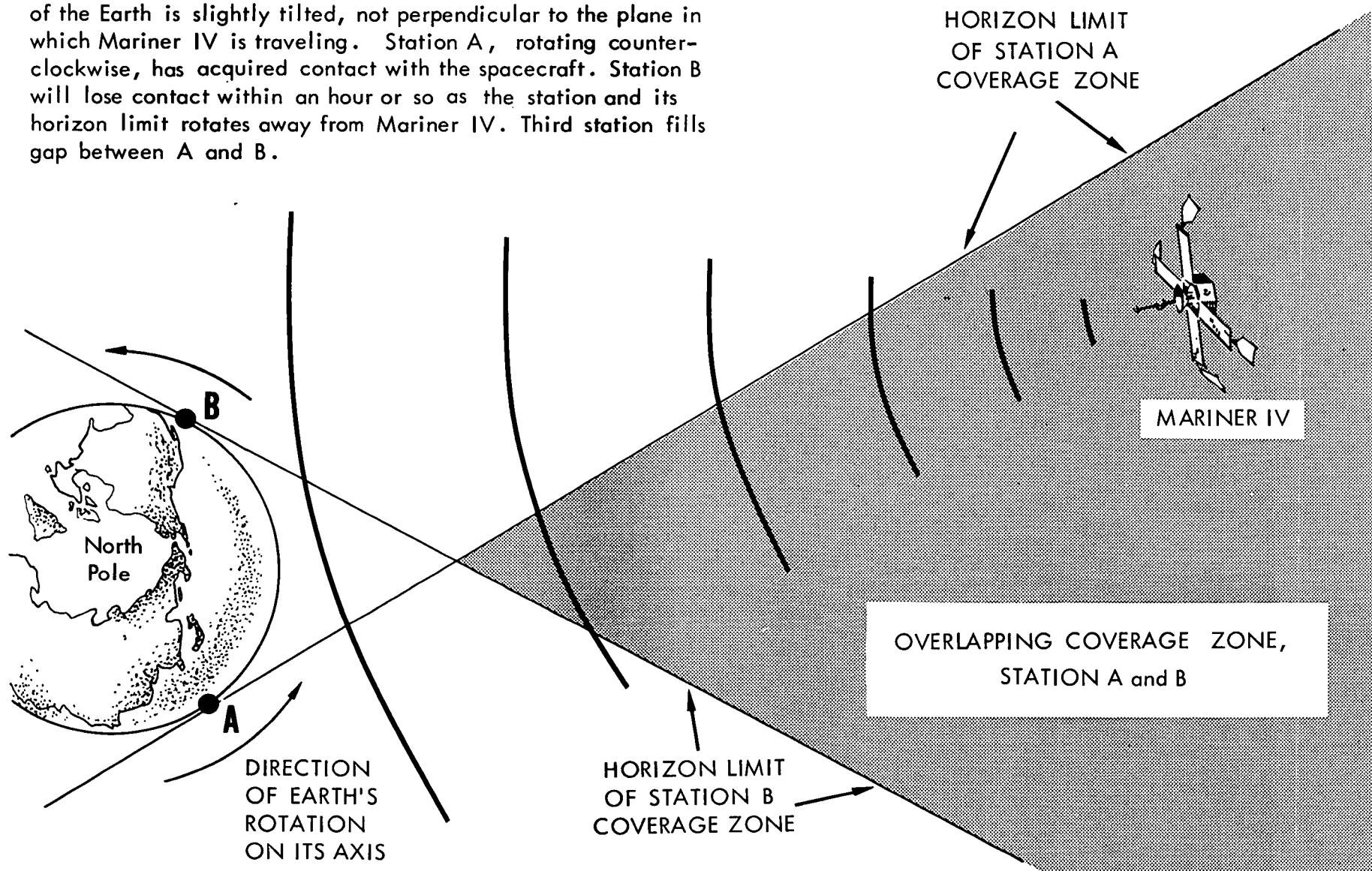
9 am	114,398,490	5,370,571	299,400,000
9 pm	114,850,910	5,249,309	

6/23

9 am	115,303,120	5,128,199	301,500,000
9 pm	115,755,513	5,007,233	

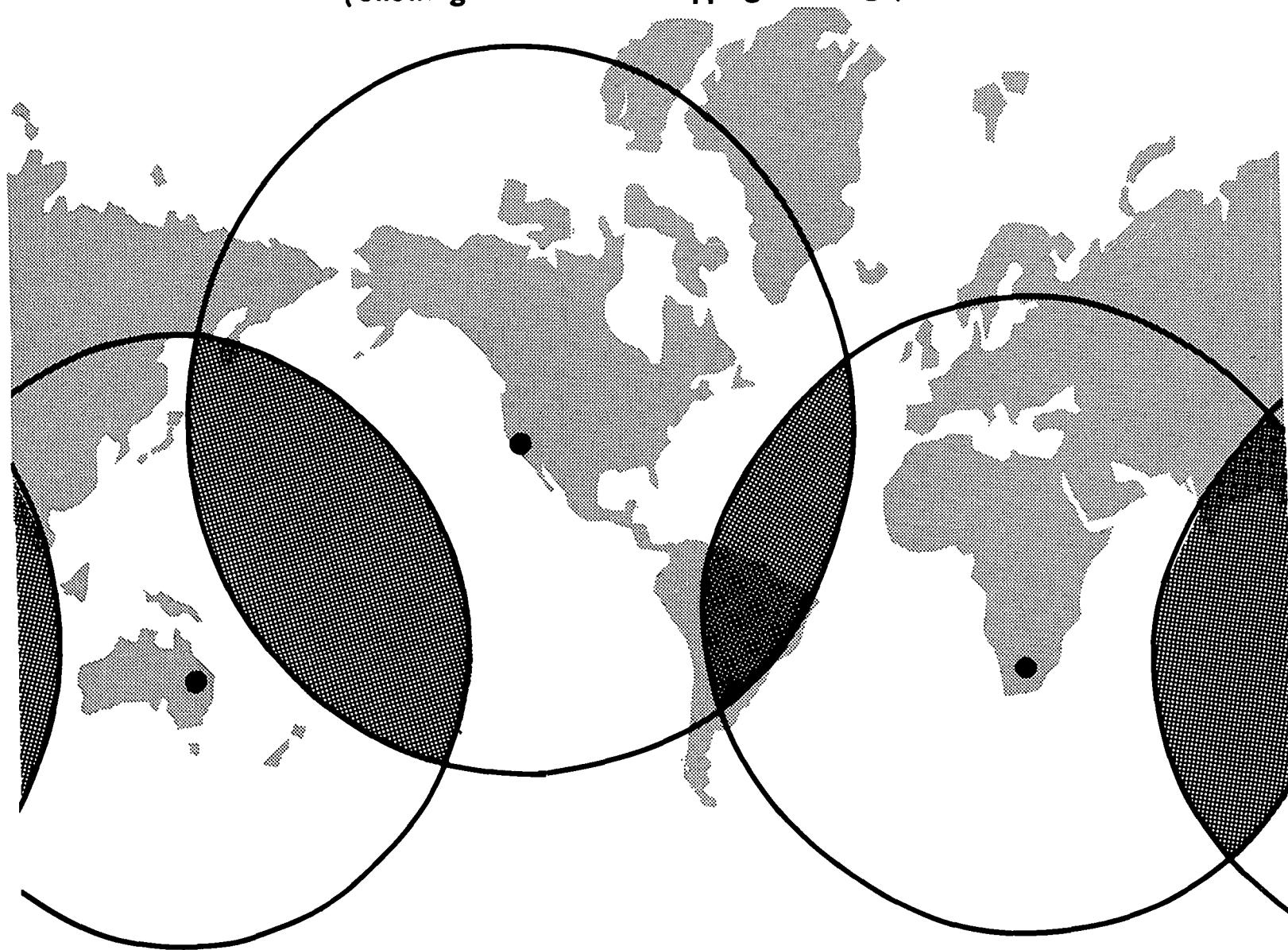
# COMMUNICATIONS WITH MARINER IV

Simplified sketch illustrates how the three Deep Space Network Stations of NASA (two shown) maintain around-the-clock communications with Mars-bound Mariner IV. Actually, the stations are located somewhat above and below the Equator and the axis of the Earth is slightly tilted, not perpendicular to the plane in which Mariner IV is traveling. Station A, rotating counter-clockwise, has acquired contact with the spacecraft. Station B will lose contact within an hour or so as the station and its horizon limit rotates away from Mariner IV. Third station fills gap between A and B.

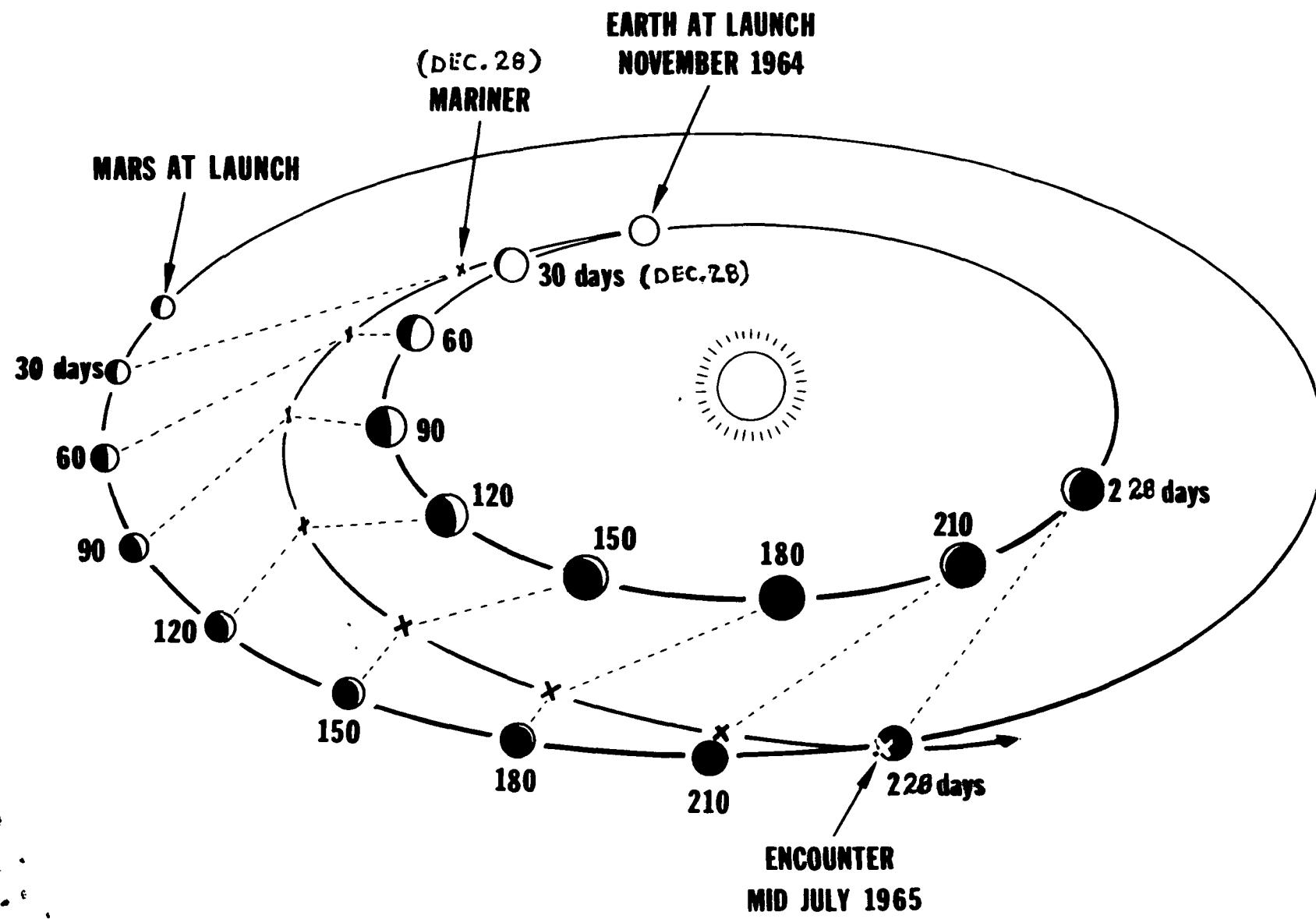


# VISIBILITY OF DEEP SPACE STATIONS

(Showing areas of overlapping coverage)



# MARINER TRAJECTORY TO MARS



The following table shows Mariner IV's velocities and positions projected for the remainder of the week with times in Eastern Standard Time:

<u>Date</u>	<u>Miles From Earth</u>	<u>Velocity Relative To Earth</u>	<u>Velocity Relative To Sun</u>	<u>Actual Distance Travelled (3a.m.)</u>
Dec. 28				
9 a.m.	5,097,388	7,215 mph	71,961 mph	52,405,965
9 p.m.	5,183,446	7,245	71,897	
Dec. 29				
9 a.m.	5,269,830	7,277	71,832	54,131,955
9 p.m.	5,356,564	7,312	71,766	
Dec. 30				
9 a.m.	5,443,671	7,348	71,700	55,856,811
9 p.m.	5,531,173	7,387	71,632	
Dec. 31				
9 a.m.	5,619,092	7,427	71,565	57,574,471
9 p.m.	5,707,455	7,469	71,497	
Jan. 1				
9 a.m.	5,796,281	7,514	71,428	59,290,879
9 p.m.	5,885,595	7,560	71,358	
Jan. 2				
9 a.m.	5,975,421	7,608	71,288	61,003,977
9 p.m.	6,065,785	7,658	71,218	